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ABSTRACT

This document reports on a field test of Developing Mathematical Processes (DMP), a research based instructional program for elementary school children developed from psychological principles. The field test was conducted in eight schools; four were multiunit schools in small towns and large cities; four were conventionally organized and located in large urban areas. Its purposes were to (1) determine the effectiveness of the program in terms of student achievement, (2) gauge the impact of an inservice program on teacher performance, and (3) document the usability of the instructional program. DMP was demonstrated to be a viable program for elementary school children at the kindergarten and first grade levels on the basis of the data gathered in the field test. (DP)

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TECHNICAL REPORT NO. 248

DEVELOPING MATHEMATICAL PROCESSES: A REPORT OF THE 1971-72 FIELD TEST

REPORT FROM THE QUALITY VERIFICATION PROGRAM

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WISCONSIN RESEARCH AND DEVELOPMENT
CENTER FOR COGNITIVE LEARNING

THE UNIVERSITY OF WISCONSIN
Madison, Wisconsin

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RESEARCH
COGNITIVE LEARNING
DEVELOPMENT

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Technical Report No. 248

DEVELOPING MATHEMATICAL PROCESSES: A REPORT OF THE 1971-72 FIELD TEST

by

W. Donald Hubbard

Report from the
Quality Verification Program

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The University of Wisconsin

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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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Abstract

A field test of the first two levels of Developing Mathematical Processes was conducted in eight schools. Four were multiunit schools located in settings ranging from small town to large city; the remaining schools were conventionally organized and located in large urban areas. The purpose of the field test was (a) to determine the effectiveness of the instructional program in terms of student achievement, (b) to gauge the impact of an inservice program on teacher performance, and (c) to document the usability of the program.

The results of the field test indicated a mastery level on the specific objectives of the program within the range of 70% to 80%. In addition there was evidence to support the notion that students enhance their mastery level over time, reaching a mastery level within the range of 78% to 87%. This was clearly true in the first grade, although kindergarten students experienced a slight decline in their mastery level. The data on teacher performance established that the inservice program was a positive influence on the behavior of teachers with the exception of those aspects related to managing the instructional program. Of particular interest is the fact that 80% of the teachers were able to implement the activity approach to teaching/learning that is specified by the developers. Finally, in regard to the usability of the program, the field test established that teachers will expend the effort to attend frequent inservice meetings, to prepare an appreciable amount of instructional materials, and to plan for the several instructional modes in the program. In addition, it was determined that students will enthusiastically participate in the learning activities, and in fact opt to use them during their elective time. Developing Mathematical Processes was demonstrated to be a viable program for elementary-school children at the kindergarten and first-grade levels on the basis of the data gathered in the field test.

I
Introduction

Overview

Developing Mathematical Processes (DMP) is a research-based instructional program for elementary-school children that has been developed with the guidance of sound psychological principles. Three underlying themes run through the range of the DMP materials: (a) a measurement conceptualization of numbers, (b) an activity approach to teaching/learning, and (c) an instructional management system that provides for learning differences in students.

The measurement theme utilizes the attributes of length in conjunction with conceptual processes to provide a developmental sequence of instructional objectives that leads to firm understanding of mathematical processes. The activity theme involves children working individually, in small groups, or in large groups; the teacher serving as a resource person rather than a lecturer; and the extensive use of physical materials to make abstract mathematical ideas more concrete. Instructional management is consistent with the more comprehensive system of educational programs called Individually Guided Education (IGE).[1] The IGE system is designed for the individual student in such a way that planned variations are made in what the student learns, the rate at which he learns it, and the mode of instruction.

It is apparent that the DMP program cannot be implemented in schools without careful consideration for the distinctions which separate DMP from other mathematics programs. A systematic iterative inservice program has been developed to assist schools in implementing DMP. The program consists of a series of meetings using pamphlets, audiovisual materials (in preparation), and guides which describe the most effective teacher/learning environments and provide the background information necessary to implement the program. For more detailed information related to DMP, see Working Paper No. 74.[2]

Objectives of DMP

Terminal Objectives

The primary terminal objective of the DMP curriculum materials is that children upon completion of the program be able to translate problems from the everyday world into mathematics, solve the problems mathematically, and translate the results back into the everyday world. This objective is based on the assumption that children's learning is rooted in their experiences. Mathematics for children is merely a language used to represent and convey information about common situations. A second and initially less important terminal objective is that children upon completion of the program be able to examine mathematics, identify the structural properties and relationships in mathematics, and logically validate mathematical assertions. This second objective can be reached only after children have had an opportunity to develop considerable

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[1] Klausmeier, H. J., Quilling, M. R., Sorenson, J. S., Way, R. S., & Glasrud, G. R. Individually Guided Education and the Multiunit Elementary School. Madison, Wis.: Wisconsin Research and Development Center for Cognitive Learning, 1971.

[2] Romberg, T. A., McLeod, D. B., & Montgomery, M. E. Blueprint for the Developing Mathematical Processes Implementation Program. Wisconsin Research and Development Center for Cognitive Learning, Working Paper No. 74, 1971.

knowledge of mathematics. Only then can they begin to examine the characteristics of different systems and the properties of those systems.

Specific Objectives

Each level of the DMP program contains a series of specific behavioral objectives. At the first level there are 28 specific objectives of two general types, arithmetic and geometry. The second level has 33 specific objectives of the same types. Objectives in probability and statistics are specified in the later levels. The criterion for an effective implementation of DMP is mastery upon completion of a particular level of 80% of the specific objectives for that level and progress by the student on the remaining objectives.

Segments of the DMP Program

The following three segments were developed for the field test version of the DMP program:

1. Instructional materials
   - The Teacher's Guide is the primary source of information and guidance for implementing the program. It is a detailed exposition of objectives, activities, instructional recommendations, and supplemental suggestions. The teacher uses the guide extensively as he implements the program.
   - The manipulative kit contains both commercially available instructional aids and locally purchased common items.
   - The printed materials package contains activity cards, student practice sheets, and other student materials.
2. Assessment materials
   - An assessment manual provides assistance for using the assessment instruments.
   - Topic inventories are used in conjunction with a systematic procedure of teacher observation to assess the student's mastery of the objectives.
   - Placement inventories are used to make judgments regarding the initial grouping of students for instruction.
   - Pupil performance records are a set of materials used to record student achievement in several different modes.
3. Inservice package pamphlets
   - An Activity Approach to Math describes the teaching styles of the teacher and the learning styles of the student that the developers feel have been the most successful in the effective implementation of the program.
   - Managing an Individually Guided Mathematics Program outlines a strategy that teachers can employ using DMP materials in order to adapt to the individual achievement levels of the students.

Requisites for Effective Implementation

The following conditions are considered to be requisite for effective implementation of the program:

1. Attendance of the teaching staff (principals optional but desirable) at an inservice meeting sponsored by the developer and held prior to implementation of the program
2. Instruction using DMP for at least 1 1/2 hours per week for students in their first year of school and 2 1/2 hours per week for students in their second year of school
3. Participation of the teaching staff in conferences and consultations with the inservice coordinator under arrangements that are mutually convenient (In general it is anticipated that the conferences will be held biweekly for a period of approximately 1 hour. This arrangement is expected for the first semester, with a reduction to monthly conferences in the second semester.)
4. Demonstration of a teaching style that includes the following components:
   a. providing materials for activities
   b. opening activities by posing problems or demonstrating an activity
   c. grouping students for effective instruction as described in the Teacher's Guide
   d. moving from group to group to serve as a resource to particular needs
   e. conducting discussions for summarizing and extending ideas of an activity
5. Attention to the assessment procedures and classroom management guidelines which include:
   a. use of the observational/pupil performance record procedure to assess the students' progress
   b. use of topic inventories to substantiate teacher judgment and, in conjunction with the placement inventories, to determine the achievement levels of students
   c. selection of activities for instruction in regard to the appropriateness for a given objective and a given distribution of achievement levels

d. formation of instructional groups based upon judgments of a student's achievement level and learning style

6. Attendance of the teaching staff (principals optional but desirable) at a midyear inservice meeting sponsored by the developer

Objectives of the Field Test

The principal objective of a field test is to determine whether the program meets its own objectives when installed and implemented according to plan (see the preceding requisites). A field test, however, may have additional objectives which extend the design and instrumentation beyond that required to evaluate the program objectives.

For the DMP field test four additional objectives were specified. Two of them involved student achievement in terms of standardized test results and the maintenance of mastery levels of specific objectives. Two field test objectives involved implementation considerations. One dealt with the underlying principle of DMP that the proper teaching/learning environment is crucial to the implementation of the program. The environment includes a teaching style that modifies the role of the teacher from authoritarian to facilitator, a learning style that involves an activity approach using manipulative materials, and an instructional focus on the measurement process which is assumed to support mathematical content. The fifth objective focused on those aspects of a program that concern school people when they contemplate its adoption: cost, staff responsibilities, time allocation, and usability of the materials.

The objectives of the field test were as follows:

1. To determine whether the objectives of the program are met (See p. 1.)
2. To determine whether the achievement of children using the DMP program as measured by norm-referenced standardized measures and by criterion-referenced DMP achievement measures is equal to or greater than that of children not using the program
3. To determine the maintenance of the students' achievement on DMP objectives previously mastered
4. To document the degree to which the teaching/learning environment advocated in the inservice package is implemented
5. To document the characteristics of DMP implementation
   a. cost
   b. staff responsibilities
   c. time allocation
   d. usability of materials

II
Method

Subjects

In eight schools all children in their first two years of school and their teachers participated in the field test; none of the students or teachers had previously used DMP. Four of the schools were located in central city areas and were organized conventionally into self-contained classrooms in contrast to the second group of four schools, which all utilized the multiunit pattern of school organization. One of the multiunit schools was in an urban but noncentral city area, while the remaining three schools were in medium-sized cities. The choice of central city and multiunit schools was made because of the Center's particular interest in determining the program's effectiveness in these settings.

As shown in Table 1, approximately 1500 children and 41 teachers were included in the study; it should be noted that each kindergarten teacher had two classes and that the higher ratio of teachers to students in the multiunit schools reflects the fact that the unit leader and teachers in a unit, which sometimes included students through third-grade level, had responsibility at various times for mathematics instruction for children at the K-1 level.

In spring 1971 most of the participating teachers attended meetings at which the DMP program and the field test were described; they then were invited to cooperate in the field test, and their participation, in general, was voluntary. A memorandum of agreement (Appendix A) was discussed with the teachers and subsequently signed by the appropriate administrator.

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Instrumentation

Specific instruments are associated with each objective of the field test.

Objective 1

The terminal objectives of the program will be assessed by instruments to be developed for administration in later stages of the program. These instruments will be designed to structure situations in which the student can perform tasks that indicate mastery of the terminal objectives.

Specific objectives were assessed by using the topic inventories, which are criterion-referenced instruments. Some specific objectives, however, could be assessed only by teacher observations; these were recorded in the pupil performance records.

Objective 2

The objectives related to the comparisons between students who have used DMP and those who have not used DMP will be assessed at a later time by standardized measures.

For comparisons in the primary grades, the arithmetic sections of the California Achievement Test and the Cooperative Primary Test were administered to students one year ahead of those students using DMP. In the succeeding year students who are using DMP will be tested with the same instruments. It was felt that these comparisons are most reliable for students beyond their second year in school, hence the assessment of this objective has been delayed until spring 1973.

Objective 3

Repeated testing of the specific instructional objectives over stated time lengths will indicate the maintenance of achievement of those objectives.

TABLE 1
DESCRIPTION OF SCHOOLS AND PARTICIPANTS

School and City	Description	Organization	Kindergarten Classes	Kindergarten Teachers	Grade 1 Classes	Grade 1 Teachers
Willard, Chicago	central city	conventional	4	2	4	4
Parkman, Chicago	central city	conventional	4	2	3	3
Hamline, Chicago	central city	conventional	4	2	3	3
Fourth Street, Milwaukee	central city	conventional	2	1	2	2
		Subtotal	14	7	12	12
Victory, Milwaukee	urban, noncentral	MUS	4	2	3	4
Morgan Martin, Green Bay	medium-sized city	MUS	4	2	4	4
Lawrence Lawson, Sparta	small city	MUS	2	1	3	4
Galesville	small city	MUS	2	1	3	4
		Subtotal	12	6	13	16
		Total	26	13	25	28

Objective 4

Instrumentation for this objective was developed in conjunction with the inservice program. An observation schedule (found in Appendix B) was piloted in the early stages of the field test and used in the later stages to assess the mastery of teachers' performance objectives.

Objective 5

Data relative to the implementation of the program were gathered from several sources. The observation schedule for Objective 4 provided some of the data. The rest of the information was obtained using questionnaires and interview schedules (Appendix C).

Testing and Monitoring Sequence

The evaluation of DMP is complex because the objectives are broader and more difficult to assess than those in most math programs. Ideally, the plan would include frequent comprehensive testing periods tailored to assess the individual's most recent instruction. Realistically, the testing periods must be infrequent and representative in order to minimize the disruption of classroom programs. The compromise between ideal conditions and realistic conditions is to use relatively frequent representative testing periods. To accomplish the compromise without bias, a stratified random sampling procedure was used that involved the following steps for evaluation of Objectives 1 and 3.

1. Three times beginning in November, 1971, and continuing to May 1, 1972, classrooms in each grade level were randomly sampled in two strata: urban schools and nonurban schools. (Four visits were planned, but lack of time reduced the actual number of visits to three.)
2. Data from selected classes were gathered regarding student progress from pupil performance records.
3. In those classes selected, students were randomly chosen and data were gathered regarding achievement and its maintenance using the topic inventories.

Another component of the evaluation plan involved the inservice program (Objective 4). Inservice coordinators were sent to field test classrooms every other week for the purpose of supporting and facilitating the implementation of the program. One of the functions of the coordinators was to make systematic observations of the teacher/learner environment. These data proved useful in evaluating the implementation of the program as well (Objective 5). As noted in the previous section, the comparisons needed for assessing student achievement on standardized measures (Objective 2) will not be effected until spring 1974. Table 2 contains a summary of the field test data-gathering information.

TABLE 2
SUMMARY OF DATA-GATHERING INFORMATION

Objective	Instrumentation	Testing Schedule	Primary Analysis
1. DMP program			
a. terminal		Delayed until Spring 1975	Proportion of students performing specified tasks
b. specific	Topic inventories, Pupil performance records	Three monitoring visits between November 1971 and May 1972	Proportion of students meeting program objectives
2. Comparisons to students who do not use DMP	Arithmetic Subtest of CAT (1970), Cooperstive Primary Test: Mathematics	Baseline data, Spring 1972 Comparative Data, Spring 1973	Comparison of means and distributions
3. Maintenance of student achievement	Topic inventories	Three monitoring visits between January 1972 and May 1972	Proportion of students meeting program objectives
4. Inservice-related implementation	Observation schedule	Biweekly visits by developers as part of inservice	Proportion of teachers who receive a favorable rating
5. Other implementation aspects	Questionnaire, interview schedule		Descriptive data

III
Results and Discussion

As indicated in Table 2, the field test provided data related to four of the five objectives: student achievement on specific objectives, maintenance of student achievement, inservice-related implementation, and other implementation objectives.

Student Achievement on Specific Objectives

It was anticipated that upon completion of a level a student would have mastered (M rating) 80% of the specific objectives and would be progressing toward mastery (P rating) on the remainder of the objectives. Data to assess this level of mastery were gathered in three monitoring visits from two sources: pupil records and a topic inventory given to a sample of students.

Data from these two sources were not always conclusive. In order to do an unbiased evaluation of the usability of the assessment materials, teachers were not required to use the pupil records. Two-thirds of the teachers used the appropriate pupil records and 52% of the teachers kept them up to date. It was decided to base statements related to student achievement on data obtained from testing children with topic inventories and to use the pupil record data for comparison purposes.

The procedure for testing children using the topic inventories was to determine the students' progress in the instructional sequence, randomly select six students, and then administer the topic inventory covering the most recent topic(s). The data gathered in this way indicate the level of mastery on the most recent topic(s), but do not provide a complete history. Furthermore, the topic inventories do not assess a uniform number of objectives or a uniform period of instructional progress. Finally, as the data in Table 3 indicate, the schools did not progress through a level at the same rate. Thus, the data can best be described as estimates of the student's mastery level on his most recent instructional period, the length and composition of which are determined by his place in the instructional sequence.

TABLE 3
MEAN PROPORTION OF LEVEL COMPLETED

School Type	K	Grade 1	Mean
Urban	.60	.60	.60
Nonurban	.74	.79	.77
Mean	.67	.70	.68

Table 4 contains percentages that indicate the level of mastery of specific objectives. These data are a compilation of all three monitoring visits. They do not indicate high levels of mastery, but given the early developmental stage of the instructional and assessment materials, the data do indicate a moderate level of mastery. The revision of the materials will need to reflect differences in such things as readiness levels and entry characteristics if a more reasonable and uniform level of mastery is to be obtained.

TABLE 4
PERCENTAGE OF STUDENTS ATTAINING THE SPECIFIED MASTERY LEVEL[a]

School Type	K	Grade 1	Mean
Urban	82	43	63
Nonurban	75	81	78
Mean	78	62	70

[a]M ratings on 80% of the objectives; P ratings on the remaining objectives.

Three specific objectives contribute a disproportionate amount to the urban first graders' level of mastery. They are: physical representation of weight, assignment of weight measurement, and construction of a figure on the geoboard. Although they reflect only 20% of the objectives for which ratings were given, they represent 45% of the progressing-toward-mastery (P) ratings and 57% of the nonmastery (N) ratings for urban students. Nonurban first-grade students, on the other hand, received only 9% of their P ratings and none of their N ratings on these three objectives. If the mastery level of the urban first-grade students is judged independently of these three objectives, 67% of them attain the specified mastery level. This alters the first-grade mean percentage to 74%, the urban mean percentage to 74%, and the grand total percentage to 76%

A student could fail to qualify as having attained the specified mastery level in one of two ways: (a) have no N ratings, but have more than 20% P ratings; or (b) have one or more N ratings. Table 5 contains percentages of students who failed to qualify in each of the two ways. The data are compiled from all three visits. The information presented there does not give any overall indication that either of the ways is more prevalent than the other, or that they are consistently evenly divided. (Note: In the analysis that disregards three objectives for the urban first graders, the percentages for the two types of failure are 17%/17%, which alters the first-grade mean to 15%/13%, the urban mean to 10%/13%, and the grand mean to 12%/11%.) There is no conclusive remark to be made about this analysis; that is, students fail to qualify for the specified mastery level in no systematic way. In an overall sense both ways are equally probable, but this effect is not uniformly obtained. Interaction effects are prevalent; therefore, further study with more data and a more sophisticated design is indicated.

As previously noted, the analysis performed is not entirely consistent with the stated objective, since it does not provide a complete historical perspective. A method of analysis that avoids the vagaries of the above method is simply to determine the proportion of each type of rating across all objectives, all students, and all monitoring visits. This latter method has the advantages of not being grossly perturbed by deviant ratings and not being affected by mastery criteria with differing variances. These gains, however, are not without loss. The meaning of the data becomes more vague and general. This analysis treats all objectives as alike and does not provide information on their combinations either on a student basis or on an instructional basis.

Table 6 contains the percentages of objectives mastered by all students on the three monitoring visits. The data are more supportive of statements of success than those data shown in Table 4. Comparison of the data in Tables 4 and 6 also demonstrates the distinctions between the two analyses described above. The effect of deviant cases is reduced, as shown by the increased position of the urban first graders. This result is more in line with the data obtained following removal of the objectives. A further example is shown by the reversal of the position of nonurban kindergartners with respect to nonurban first graders and urban kindergartners. Inspection of the data reveals that the overwhelming number of specific objectives (336) can be

TABLE 5
PERCENTAGE OF STUDENTS FAILING IN ONE OF TWO WAYS TO ATTAIN THE SPECIFIED MASTERY LEVEL

School Type	K	Grade 1	Mean
Urban	7/11[a]	14/43	10/27
Nonurban	12/13	12/7	12/10
Mean	10/12	13/25	12/18

[a]The first number represents percentage of failures with no N ratings, but more than 20% P ratings. The second percentage represents failures with one or more N ratings.

TABLE 6
PERCENTAGE OF OBJECTIVES RATED MASTERY (M)

School Type	K	Grade 1	Mean
Urban	82	67	75
Nonurban	89	80	84
Mean	86	74	80

mastered at an 89% rate; however, the data do not show that all of the students in the first monitoring visit (13% of the students) failed to attain the specified mastery criterion on the basis of only seven ratings (5N, 2P).

Student mastery data from pupil records were available to serve as a comparison to the results obtained. These data were teacher ratings of the students' mastery levels on the specific objectives. In each of the monitoring visits the class records were scanned and an estimate was made of the overall proportion of each rating type. Table 7 contains the estimates compiled for all three visits and expressed in percentages.

TABLE 7
ESTIMATES OF PERCENTAGE OF MASTERY (M) RATINGS

School Type	K	Grade 1	Mean
Urban	60	81	72
Nonurban	84	92	87
Mean	75	86	80

When compared to the percentages obtained by the administration of the topic inventories (Table 6), the overall figures are remarkably similar for the school type. There is a discrepancy obtained when the teachers are divided by grade level: if the kindergarten and first-grade columns were reversed, the tables would be strikingly alike. As they are presented, however, the data indicate that even though teacher ratings in general agree with subsequent ratings obtained from administrations of the topic inventories, there is some disagreement when they are separated according to grade level.

Clearly the design of the field test, the nature of the instruments (the topic inventories were in many cases in their first trial), and the timing of the field test do not permit an ironclad statement of judgment regarding the students' achievement on specific objectives. There is evidence to indicate at least moderate success; there are also indications that the program needs to be improved if the specified mastery criterion is to be attained in any reasonable fashion.

Maintenance of Student Achievement

In the second and third monitoring visits the students had progressed far enough to determine if they could maintain the specified mastery criterion on objectives taught earlier. The procedure was to determine the instructional progress of the class, randomly select six students, and administer the topic inventory that immediately preceded the topic inventory appropriate for the instructional sequence. This procedure suffers from the same problems as the one used for assessing student achievement: the procedure provides data on only a limited range of a student's history, it covers varying lengths of time and numbers of objectives, and it is not uniform for every class. The procedure does yield data that estimate the student's achievement level on objectives taught previously, i.e., what level of achievement is maintained.

Table 8 contains the percentages of students maintaining the specified mastery level of 80% of the objectives with P ratings on the remaining objectives. The first-grade students exhibited a high level of maintenance--higher, actually, than was indicated by the achievement data reported in the previous section. Thus, there is some evidence that the mastery of the specific objectives is enhanced by subsequent instruction. This statement is consistent with the intention of the developers to use and reinforce previously taught concepts in later instruction.

TABLE 8
PERCENTAGE OF STUDENTS MAINTAINING THE SPECIFIED MASTERY LEVEL[a]

School Type	K	Grade 1	Mean
Urban	69	87	78
Nonurban	55	96	75
Mean	62	92	77

[a] M ratings on 80% of the objectives; P ratings on the remaining objectives.

The opposite effect, however, is noted with kindergarten children. The maintained level of mastery is considerably lower than the level noted immediately after instruction. The effect is not quite as negative when comparable sets of specific objectives are used. This is accomplished by compiling the student achievement data on only the first two monitoring visits. Hence the objectives for which an achievement level is obtained are more nearly the same as those objectives for which a maintenance level is obtained. Table 9 contains the percentages for the student achievement of the mastery criterion and maintained achievement.

TABLE 9
COMPARISON BETWEEN STUDENTS ACHIEVING THE SPECIFIED MASTERY CRITERION[a] AND MAINTAINING THE CRITERION

School Type	K		Grade 1		Mean	
	Achieved	Maintained	Achieved	Maintained	Achieved	Maintained
Urban	86	69	67	91	77	80
Nonurban	63	55	67	97	65	76
Mean	75	62	67	94	71	78

[a]80% M rating; 20% P rating.

TABLE 10
COMPARISON BETWEEN PERCENTAGE OF MASTERY RATINGS ACHIEVED AND PERCENTAGE MAINTAINED

School Type	K		Grade 1		Mean	
	Achieved	Maintained	Achieved	Maintained	Achieved	Maintained
Urban	87	86	72	91	80	88
Nonurban	82	77	77	98	80	87
Mean	85	81	75	94	80	87

Even when the sets of objectives are made more comparable, the effects noticed before are obtained: (a) in first grade an overwhelmingly higher level of achievement maintenance than achievement level immediately after instruction, and (b) in kindergarten an indication of lower achievement maintenance than the achievement level obtained after instruction.

Remembering the susceptibility of this mode of analysis, it may be wise to balance this presentation by comparing the proportions of mastery ratings without regard to those combinations related to individual students and particular instructional patterns. Table 10 contains the comparisons between percentages of mastery ratings on specific objectives after a period of time had elapsed following instruction, i.e., achievement level of mastery compared to maintained level of mastery. The evidence still supports the improvement of achievement for first-grade students, but it is not as strong for achievement loss with kindergarten children as the analysis that utilizes the specified mastery criterion.

In summary, the data support the notion that the achievement of students on specified DMP objectives is maintained and in fact may be improved, particularly in the case of first graders. There is some evidence to suggest that kindergartners may experience a drop in their level of mastery.

Inservice-Related Implementation

The data reported in this section were collected as part of the research conducted by Douglas McLeod. The purpose of McLeod's study was to document the effect of a carefully planned inservice program on the performance of DMP teachers in their classrooms. For a more complete report of the research, see "The Effectiveness of an Inservice Program for Implementing an Activity Approach to Learning Mathematics in the Elementary School."[3]

Two raters used an observation schedule to rate each of the teachers an average of five times (combined). The period of the observations was from mid-October to mid-January. In addition to the ratings, some

[3]McLeod, D. B. The Effectiveness of an Inservice Program for Implementing an Activity Approach to Learning Mathematics in the Elementary School. Wisconsin Research and Development Center for Cognitive Learning, Technical Report No. 245, 1972.

TABLE 11
DMP TEACHER PERFORMANCE OBJECTIVES
AND PERCENTAGE OF TEACHER MASTERY

	Objective	Percentage
1	The teacher chooses activities that help students achieve the objectives of DMP.	92
2	The teacher provides the printed, manipulative, or other materials needed for the activity.	95
3	The teacher identifies the problem or the objective of the activity, providing an appropriate focus.	95
4	During the opening or closing of an activity, the teacher states the relationship of the activity to previous work.	47
5	During the opening of an activity, the teacher explains the activity clearly and in a well-organized manner.	89
6	During the closing of an activity, the teacher displays and discusses student work.	50
7	The teacher uses student ideas.	82 (95)[a]
8	The teacher does not negatively criticize a student's work.	87 (100)
9	The teacher responds to student statements by asking for validation or justification of the mathematical ideas expressed.	63
10	The teacher asks questions and leads discussion, rather than lecturing.	92
11	Given an activity that requires students to work individually, in pairs, etc., the teacher organizes the students.	95
12	The teacher moves from group to group, acting as a resource person.	95
13	The teacher allows students to move purposefully about the room.	95
14	The teacher allows students to interact verbally while working.	95
15	The teacher arranges furnishings and materials as recommended.	95
16	The teacher demonstrates mastery of the DMP objectives being studied by the students.	92
17	The teacher describes the mathematical processes being used.	58
18	Using appropriate instruments, the teacher assesses students and completes records.	71 (80)
19	The teacher states the roles of placement and topic inventories.	66 (85)
20	On the basis of information gathered, the teacher forms instructional groups based on achievement.	58
21	When presented with a student who has not mastered an objective, the teacher can choose an activity that will help the student	39
22	The teacher redirects individual students when they finish.	18
23	When given information on student achievement, the teacher classifies students on the basis of prerequisite behaviors needed to start a new topic.	55
24	The teacher identifies the various options that are made available in each topic of the Teacher's Guide.	58 (80)

[a]Numbers in parentheses indicate percentage of nonurban teachers where appreciably different.

information was gathered from questionnaires given to the teachers in January and February (after the observations were completed).

There were 24 objectives (see Appendix D) to be achieved by the teachers as a result of an effective inservice program. A teacher mastered an objective if she was observed exhibiting the stated behavior 75% of the time. For those objectives assessed by questionnaire, a mastery level was determined on the basis of the response.

More than 90% of the teachers achieved mastery on ten of the objectives and more than 80% of the teachers achieved mastery on three other objectives. The range of the mastery levels for the remaining eleven objectives was 18% to 71%. Seven of these eleven were related to managing instruction. More than 80% of the nonurban teachers who were experienced in the multiunit school organization did master three of those seven objectives related to managing instruction. Table 11 contains a summary of the percentages of teachers who mastered the 24 objectives.

Another analysis of the effectiveness of the inservice program was conducted with regard to the subset of objectives related to the activity approach of the DMP program. Objectives 1, 2, and 16 were considered essential (all three had to be mastered) and Objectives 3, 9, 10, 11, 17, and 20 were considered important (any five of them had to be mastered). In urban schools Objective 20 was dropped due to the conditions of the classroom organization that preclude the use of instructional aides within the context of a relatively higher student/teacher ratio. It was then specified that four of the remaining five objectives had to be mastered. These criteria formed the basis for determining whether teachers utilized the activity approach.

Table 12 contains the percentages of teachers who, in general, attained the objectives with regard to the activity approach. The relationship obtained in this analysis is consistent with those relationships observed in regard to student achievement.

In addition to gathering data on the teachers' level of mastery on the objectives, data were gathered on age, teaching experience, educational preparation, professional activity, and teacher attitude. No relationships were established between any of these variables and the level of mastery of the objectives or the degree of implementation of the activity approach.

TABLE 12
PERCENTAGE OF TEACHERS ATTAINING THE OBJECTIVES FOR THE ACTIVITY APPROACH

School Type	K	Grade 1	Weighted Mean
Urban	86	64	72
Nonurban	83	79	80
Weighted Mean	85	72	76

Other Implementation Objectives

The objectives discussed in this section are those related to program cost, staff responsibility, time allocation, and material usability. The purpose of the discussion is to describe those conditions that school personnel consider when deciding to implement a program.

Program implementation costs were in two areas: commercially available manipulative materials and ordinary materials purchased locally. In subsequent years there will be costs associated with printed materials for students and teachers. These costs were absorbed by the developers as a condition of the field test. With regard to the manipulative materials, the developers recommended amounts of materials that would be used by 25 to 35 students. When ordered in those proportions the cost was between $1.85 and $2.90 per student. The actual cost depended on the grade level (less for kindergarten) and the number of students in the instructional group.

No data were gathered on the actual expenses related to the locally purchased materials. Several teachers remarked on the bother that was involved in purchasing the materials and on the inconvenience that was caused when the purchased materials were not appropriate for the directions in the Teacher's Guide. As a result it was recommended that more materials be included in the commercially available manipulative kit. Some expense was borne by the schools in duplicating copies of the printed materials for students. The Milwaukee Central Office provided this service for its schools at an estimated cost of $500 for approximately 275 students.

The staff responsibilities associated with implementing the program involved extensive inservice effort, considerable preparation and planning time, and additional staff assistance. These aspects are in addition to the expectations for teacher performance which are described in the previous implementation section.

The inservice component involves two one-day workshops before school begins in the fall and hourly meetings every two weeks for the first semester of implementation. These sessions were generally well-attended, well-received, and appreciated by the teachers. A commitment to extensive inservice in the early stages of implementation is an integral part of the program, because DMP does not correspond to the conventional teaching patterns of other programs in math or other subjects.

A second increased staff need arises in relation to the inservice component of the program. The developers conducted the workshops and meetings, but this cannot be the case in the program's ultimate implementation. The design of the program calls for the identification of a DMP coordinator who would be trained by the developer and would assume the responsibility of training teachers and assisting in the implementation of the program. To the degree that the commitment is made to the inservice program, there is a concommitant staff need to identify a DMP coordinator.

Teachers found that considerable time was spent in preparing and planning for DMP. Some of this was due to the newness of the program, but most of the time was spent gathering materials, preparing activity sheets, and planning for individualized instruction. In regard to preparing activity sheets, teachers recommended that they be more readily available as in workbooks. The other time-consuming tasks, however, are necessary for the success of the program. If the teachers are left without additional resources in terms of aides and released time for planning, the implementation of DMP is going to cost the teacher increased preparation and planning time.

Teacher aides were employed not only to prepare activity sheets and gather materials but also to assist in record keeping, assessment of students, and instruction. Several teachers felt that DMP could not be implemented without aides, but the teachers in three Chicago schools proved that to be false. The implementation of the program is greatly enhanced by the availability of teacher aides, and it is encouraged by the developers, but the evidence does not indicate that it is required if the teachers are willing to expend the extra effort.

The matter of the usability of the materials regards the appropriateness of the materials for the teachers and students using the program. There are two levels of discussion: (a) a specific item-by-item accounting of the omissions, errors, and confusions that need revision; and (b) a general expression of attitude and appreciation toward the materials. Appendix E contains the formative reports that were submitted to the developers for their consideration in revision.

Generally speaking, the teachers and students enjoyed using the program. They adapted to the style and format of the materials. Children chose math for free play activity. Teachers who were initially hesitant to use the program became supporters and willing participants; no teacher chose not to continue with the program. The urban teachers were concerned by the amount of preparation/planning required and the differences in the sequencing of some topics of arithmetic, but for the most part the success and happiness of their students proved to be worth the effort. The multiunit school teachers felt that the instructional management aspects of the program were weak, but realized that the linear nature of the subject and the immature development of the assessment procedures were limiting. Revisions were instituted in the area of instructional manatement.

Summary

A field test of the first two levels of the DMP program was conducted in eight schools. Four were multiunit schools located in settings that ranged from small towns to large cities; the remaining schools were conventionally organized and located in large urban areas. The purpose of the field test was (a) to determine the effectiveness of the instructional program in terms of the achievement of the students, (b) to gauge the impact of an inservice program on the performance of teachers, and (c) to document the usability of the program.

The effectiveness of the instructional program was assessed by administering program tests to samples of students. The testing sessions were conducted during three monitoring visits made to stratified random samples of field-test schools. The tests were selected according to one of two criteria: appropriate for assessing mastery of the most recent instructional objectives, or appropriate for assessing mastery of those objectives taught just before the most recent instructional unit. Data gathered according to these two criteria provided information related to the student's achievement level and his maintenance of that achievement level.

The results of these investigations were generally satisfactory. Approximately 70% of the students attained the specified level of mastery. This percentage was not uniformly obtained in all categories of students, ranging from 43% to 82%. The differences seemed to

indicate a need to revise the materials. With regard to the maintained level of achievement, approximately 77% of the students were at the expected level of mastery. These findings suggest that student achievement levels are enhanced over time. This effect, however, was not observed for all groups. The kindergarten students maintained the expected mastery level at a lower rate, and the proportion of first-grade students attaining the specified mastery level was greatly increased.

Two other analyses were done to corroborate the results obtained regarding the effectiveness of the instructional program. First, the proportion of mastery ratings was calculated from all the ratings given in the testing sessions. This analysis is less susceptible to the disproportional influence of a few ratings on level attainment. In addition, a more long-range perspective is obtained. The results of this analysis yielded an 80% overall mastery level ranging from 67% to 89%. With regard to the maintained level of mastery, although the level of mastery is higher (overall 87%), this analysis yielded the same relationships observed for the primary analysis.

The second corroborating analysis involved estimates of the teachers' ratings of students' mastery of the objectives. These data were gathered from pupil records as part of the monitoring visits. The data yielded an 80% mastery rate and maintained the distinctions between the urban and nonurban classrooms that had been observed in the other two analyses. A discrepancy was found, however, between the ratings provided by teachers when divided according to grade level and the ratings obtained from test administrations.

Taking all three analyses in account, the overall mastery level can be judged to be somewhere in the range of 70% to 80%. In addition there is evidence that first-grade students enhance their levels of mastery over time (ranging from a gain of 19% to 27%), while kindergarten students diminish their mastery level (ranging from a loss of 4% to 13%).

The impact of the inservice program on the performance of teachers was assessed by a systematic observation schedule in conjunction with interviews and questionnaires. Twenty-four performance objectives were set for the teachers of DMP. Ten of the objectives were mastered by at least 90% of the teachers, and three other objectives were mastered by more than 80% of the teachers. Of the remaining eleven objectives, seven of them involved the instructional management aspects of the DMP program. More than 80% of the nonurban teachers mastered three of the seven management objectives.

A subset of nine objectives was formed to characterize the implementation of an activity approach to teaching/learning. The objectives of the activity approach were mastered by 76% of the teachers. The results ranged from 64% for urban first-grade teachers to 86% for urban kindergarten teachers.

The usability of the program was well documented. Teachers increased their support for the program; students selected DMP math for elective opportunities. The most dramatic evidence came from the enthusiasm of students who convinced reluctant teachers not only to use the program, but to encourage their colleagues to carry it on in the next levels. The program cannot be implemented, however, without an expenditure of faculty effort and staff resources which goes beyond the conventional elementary mathematics program. There is an extensive inservice program which involves staff time and eventually the selection of a coordinator to assume the tasks that were performed by the developers during the field test. It is assumed that instructional aides are needed to prepare materials and assist in the instruction, or that teachers will devote the extra effort in the absence of aides (Chicago teachers being a case in point). All of these considerations are in addition to the necessity for teachers to adapt to an innovative program that utilizes different procedures and different materials.

The field test clearly established that teachers will expend the effort, that they will adapt to the program, that students will master the objectives, and that both teachers and students will be enthusiastic about the endeavor.

Appendix A
Memorandum of Agreement

Developing Mathematical Processes: Books 1 and 2

The Wisconsin Research and Development Center for Cognitive Learning and the Milwaukee School District agree cooperatively to field test during the 1971-72 academic year instructional materials in mathematics developed by the Center. The field test will be conducted in Victory and Fourth Street Schools with all children in their first and second years of school.

The Center will provide:

1. Two days of staff inservice prior to the opening of school and one day of staff inservice mid-year. Participating teachers will be reimbursed at their usual hourly rate for such inservice; teachers from Victory School will be reimbursed for two half-days (4 hours) of inservice and teachers from Fourth Street School will be reimbursed for two full days of inservice.
2. All materials for teachers and all printed instructional materials for children with the exception of manipulative aids.
3. Criterion-referenced tests directly associated with the instructional program and tests associated with the gathering of criterion data.
4. Feedback to school systems regarding the field test results in the form of a written report. The initial report will be provided by August 20, 1972, with a more extensive report to follow by December 30, 1972.
5. Feedback and assistance to the cooperating staff at least once every two weeks during the first semester and at least once a quarter thereafter in the form of a half-day visit by a Center staff person.
6. A nonprofessional quarter-time person (aide) to assist the cooperating teachers in Fourth Street School in implementing the program. The Center will reimburse the Milwaukee Public Schools up to a maximum of $1500 upon the submission of invoices for staff released time.

The School District will:

1. Provide the manipulative aids required for program implementation as per the attached schedule.
2. Engage all eligible first- and second-year pupils and staff in the participating school(s) in the program.
3. Pay any shipping costs for returning tests to the Center.
4. Devote a minimum of one and one-half hours weekly to mathematics in classes for children in their first year of school, and two and one-half hours weekly for children in their second year of school.
5. Provide up to two hours of pupil time for the gathering of criterion data yearly, apprise the Center of the local testing program, and share with the Center any intelligence or achievement data from the participating schools gathered throughout the system's testing program.
6. Inform the Center in advance of school boundry changes affecting over 10% of the enrollment of a given school, so that termination of the tests at the affected grade levels can be jointly considered.

It is furthermore understood that the 1971-72 school year is the first year of the mathematics field test, and that the Center and school anticipate continuation of the test in at least the 1972-73 school year and for children in their third and fourth years of school, should both parties agree that the first year of the test is successful.

Herbert J. Klausmeier, Director
Wisconsin Research and Development
Center for Cognitive Learning

(Signed)

(Position)

Appendix B
Observation Schedule

DMP Inservice--Form I Draft - Oct. 1, 1971

I. General

I.1. Identify the school (G-E, LL, MM, 4, V, C-H, C-P, C-W), the observer (by initials), the teacher (by code number), and the date of the observation.

I.2. Give the label of the activity observed; if the activity is not taken from the Teacher's Guide, describe it briefly. If the teacher is in charge of students who are working on more than one activity, describe each of the activities. (Use labels if possible.)

I.3. Find out from the teacher the activity done just previous to the one observed.

I.4. Find out from the teacher the activity that she plans to do next. If she has not decided which activity to do next, write "ND" and state any reasons that she may offer for not deciding until later.

II. Materials

II.1. Identify the DMP printed materials used.

II.2. Identify the manipulative materials used.

II.3. Identify other materials (e.g., crayons or graph paper) that are used in the activity and important to the success of the activity when these materials have been provided by the teacher.

III. Structuring Comments--Opening and Closing Activities

III.1. If the observation includes the opening of the activity (or a part of an activity), mark O; for the middle or closing of an activity, mark M or C, respectively.

III.2. F. Focus--The teacher identifies the problem and/or the objective of the activity (during the opening or the closing, usually). Yes No

III.3. R. Relationship--The teacher states the relationship of this activity to previous work. Yes No

III.4. *C. Clarity--The teacher explains or summarizes the activity clearly and in a well-organized manner, presenting ideas at a cognitive level appropriate for her students. Yes No

III.5. SW. Students Working--State the ratio of the number of students working profitably on the activity to the number of students not working or confused. 0 - less than 25%, 1 - 25% up to 50%, 2 - 50% up to 75%, 3 - 75% or more.

III.6. D. Displays--The teacher displays and discusses student work at the close of the activity as she works for cognitive closure. Yes No

IV. Structuring the Classroom (during the middle or main part of the activity)

IV.1. G. Grouping--The teacher organizes the students to work on the activity individually, in pairs, in small groups of 3 to 10, or in large groups of 11 or more. (Mark 1, 2, 3, or 4, respectively.)

IV.2. TM. Teacher Movement--The teacher moves from group to group (or individual to individual) in order to act as a resource person for the students. Yes No

IV.3. SM. Student Movement--Students move purposefully about the room to obtain materials, to consult with others, or for other task-oriented reasons. Yes No

IV.4. I. Student-Student Interaction--Students interact verbally while working on the activity. Yes No

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*High-inference

IV.5. RO. Room Arrangement--The teacher arranges furnishings and materials in the room in a way that is appropriate for the activity. (For example, this behavior is demonstrated when the teacher puts several desks together to form a work area for a small group, following suggestions from the description of the activity.) Yes No

IV.6. *A. Assessment--The teacher assesses a student on the objectives of the activity by observation, i.e., the teacher observes a student apparently for purposes of assessment, whether or not the assessment is recorded. Yes No

IV.7. RA. Records Assessment--The teacher records her observations of student achievement in the pupil performance records. Yes No

IV.8. RD. Re-Directs--The teacher re-directs students when they finish an activity. Yes No

V. Verbal Behavior of the Teacher

V.1. U. Use of student ideas--The teacher uses student ideas by repeating them, modifying them, applying them, comparing them to other ideas, or by summarizing them. Yes No

V.2. P. Probing--The teacher probes a student response--i.e., the teacher asks a student or a group of students to justify or clarify a statement or to validate a mathematical statement. Yes No

V.3. C. Criticism--The teacher criticizes a student's contribution to a group discussion or to other group work. Yes No

V.4. *A. Authority--The teacher acts primarily as a mathematical authority figure rather than asking students to validate or justify their answers. Yes No

V.5. Q. The teacher asks questions about mathematical ideas related to the activity. Yes No

V.6. *L. The teacher uses lecture methods primarily rather than inquiry techniques when discussing mathematical ideas related to the activity. Yes No

*High-inference

Appendix C
Questionnaire

Please respond to the following questions so that we might improve the assessment management aspects of the DMP program. Please respond to each question as completely as you feel is necessary. Use the back of the form or additional pages if needed.

1. Do you feel that the assessment package is generally usable?_____

2. Do you feel that the assessment package is generally useful?_____

3. How did you use the Placement Inventories?_____

4. How did you use the Topic Inventories?_____

5. Are the Pupil Performance Records designed to be useful to you?_____

6. Were the check-up tests useful? How did you use them?_____

7. Did you find the observation scheme useful? How frequently were you able to use it?

8. Did you group your students for DMP instruction?_____

9. If you did not group, what would you need in order to do grouping?_____

10. If you did group, was the assessment package helpful in this regard? Which part of the package was the most helpful?_____

11. If the assessment package did not help you in grouping, how could we improve the package so that you could use it?_____

12. If the assessment package did not help you in grouping, how did you form your groups?_____

_____

13. Is there any general information that you would like to share with us so that we might improve DMP?_____

_____

INTERVIEW SCHEDULE

Please look for answers to the following questions.

1. Is DMP a manageable program in its complete form? (instruction, assessment, management)
2. Is DMP applicable to all children and all school settings?
3. Is the assessment package a reasonable expectation for teachers?
4. What is the style that the teacher used for adjusting to children of varying ability, interests, and achievement?
5. Did the DMP materials assist in the style of No. 4?
6. Could the DMP materials be better designed to assist in the style?
7. What is the general impression of teachers about DMP?

Appendix D
Objectives for DMP Teachers

The main purpose of establishing the following objectives for DMP teachers is to provide a basis on which to evaluate the teachers' implementation of the program. Assessing the teachers' achievement of these objectives will provide information on the effectiveness of the DMP inservice program and the usability of other DMP materials. A revised version of these objectives will be developed for future teachers of DMP to guide them as they assess their own effort to implement the program.

The objectives for DMP teachers will be listed here in two main categories--providing instruction and managing instruction. Providing instruction will be subdivided into objectives dealing with the materials used by the teacher, the teacher's structuring comments (such as advanced organizers and post organizers), the interaction between students and the teacher, the organization of the classroom, and the teacher's knowledge of the mathematical content of DMP. Objectives related to managing instruction deal primarily with the decisions that the teacher needs to make in order to provide individually guided education, and how the assessment information is used in making these decisions.

The statement of each objective will be accompanied by whatever extra explanation is required and by one or more ways to measure the achievement of that objective. When classroom observation is used to measure achievement of an objective, the number of each related item of the Observation Schedule will be given. When the assessment is by questionnaire, the number of the item in Questionnaire A will be given. The Observation Schedule and Questionnaire A are included in Appendix B.

PROVIDING INSTRUCTION

The objectives for DMP teachers specified in this section will deal primarily with the type of instruction provided by the teacher. Sometimes an objective will be subdivided into several parts, and these subcriteria will be used to determine whether a teacher has demonstrated achievement of a particular objective.

Use of DMP Materials

1. The teacher chooses activities (usually but not necessarily from the DMP Teacher's Guide) that help students achieve the objectives of DMP.

Assessments: Observation Schedule - I.2, I.3, and I.4

If the teacher never used any of the activities from the DMP Teacher's Guide, or if the teacher chose to do activities that were in conflict with the objectives of DMP, the teacher's performance on this objective would be considered unsatisfactory.

2. The teacher provides the printed, manipulative, or other materials needed for the activity.

Assessment: Observation Schedule - II.1, II.2, and II.3

The materials needed for each activity are specified in the DMP Teacher's Guide. The printed and manipulative materials that are part of the DMP Curriculum Package should be available for each teacher to use; it is expected that other materials, such as scissors and graph paper, will be available from local sources.

Structuring Comments

3. The teacher identifies the problem or the objective of the activity, providing an appropriate focus.

Assessment: Observation Schedule - III.2

4. During the opening or closing of an activity, the teacher states the relationship of the activity to previous work.

Assessment: Observation Scehdule - III.1 and III.3

Objectives 3 and 4 are to evaluate the teacher's use of structuring comments that provide an overview of what is to come or a review of what has gone before. Providing this type of cognitive scaffolding seems to be particularly important when beginning or ending an activity (Rosenshine & Furst, 1971; Romberg & Wilson, 1970).

5. During the opening (or closing) of an activity, the teacher explains (or summarizes) the activity clearly and in a well-organized manner, presenting ideas at a cognitive level appropriate for the students.

Assessment: Observation Schedule - III.4

The clarity of the teacher's presentation is an important variable in teaching, but difficult to measure, involving as it does a high-inference judgment on the part of the observer (Rosenshine & Furst, 1971). To get independent information on this objective, a separate criterion will also be used. This criterion is Item III.5 of the Observation Schedule, which asks the observer to state the ratio of the number of students working profitably on the activity to the total number of students involved. Of course, this ratio may also be affected by other factors, such as time of day, that are not related to the clarity of the presentation.

6. During the closing of an activity, the teacher displays and discusses student work, while helping students work for cognitive closure.

Assessment: Observation Schedule - III.6

This objective is very important for some activities, such as when students first begin to construct graphs. For other activities, however, there may be no written work to be discussed and this objective would not apply.

Teacher-Student Interaction

7. The teacher uses student ideas by repeating them, modifying them, applying them, comparing them to other ideas, or by summarizing them.

Assessment: Observation Schedule - V.1

There is considerable research evidence that this type of teacher behavior is related to student achievement and attitude (Flanders, 1969).

8. The teacher does not negatively criticize a student's contributions to a group discussion or to other group work.

Assessment: Observation Schedule - V.3

Negative criticism tends to be correlated with lower student achievement (Flanders, 1970; Rosenshine & Furst, 1971). The Observation Schedule scores occurrences of negative criticism of student contributions, but not criticism of destructive or dangerous student behavior.

9. The teacher responds to student statements by asking for validation or justification of the mathematical ideas expressed.

Assessment: Observation Schedule - V.2 and V.4
Questionnaire A - Items 8 and 9

Several criteria will be used to assess this objective. First, observers will note occasions when the teacher asks students to validate or justify a mathematical statement (V.2). Second, the observer will make a high-inference judgment as to the teacher's usual behavior--is it that of a mathematical authority figure who normally tells students what is mathematically correct or incorrect (V.4), or is it that of a resource person who encourages students to justify their statements? Third, Items 8 and 9 of Questionnaire A ask the teacher how he would respond to a mathematical statement by a student.

10. The teacher asks questions and leads discussions, rather than lecturing.

Assessment: Observation Schedule - V.5 and V.6

DMP activities are designed to be used in an inquiry-oriented classroom where the teacher spends very little time lecturing. The two criteria for this objective determine, first, whether the teacher asks questions or not (V.5), and second, whether the teacher relies primarily on questioning methods or lecture methods (V.6).

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Organization of the Classroom

11. Given an activity that requires students to work individually, in pairs, in small groups, or in large groups, the teacher organizes the students in the appropriate mode.

Assessment: Observation Schedule - IV.1

The appropriate group size depends on the requirements of the particular activity being used. However, it is expected that the children will spend most of their time in individual and small group activities.

12. The teacher moves from group to group or from individual to individual, acting as a resource person for the students.

Assessment: Observation Schedule - IV.2

This is an important behavior because moving about the room gives the teacher the opportunity to assess the students, to ask probing questions that extend the child's understanding, and to provide extra help when this is needed.

13. The teacher allows students to move purposefully about the room to obtain materials, to consult with others, or for other task-oriented reasons.

Assessment: Observation Schedule - IV.3

14. The teacher allows students to interact verbally while working on the activity.

Assessment: Observation Schedule - IV.4

15. The teacher arranges furnishings and materials in the room in a way that is recommended for the activity by the Teacher's Guide.

Assessment: Observation Schedule - IV.5

In Objectives 13, 14, and 15, the teacher is expected to provide a classroom environment that is conducive to an activity approach to learning mathematics. Students, for example, should have access to manipulative materials so that they can validate their assertions empirically, and developmental psychologists such as Lovell (1972) have often noted the desirable effects on learning of student-student interaction. Also, the classroom needs to be arranged so as to provide the facilities needed for the activity, such as areas where small groups can work together solving problems.

Mathematical Content of DMP

16. The teacher demonstrates mastery of the DMP objectives being studied by the students.

Assessment: Classroom Observations

17. The teacher describes the mathematical processes that are being used by his students.

Assessment: Questionnaire A - Item 15

Classroom observations have shown that DMP teachers in kindergarten and first grade do not have any difficulty in mastering the related student objectives. Teachers do have some difficulty, however, in describing the processes that the students use and in seeing where the processes lead. The teachers were asked to describe three of these processes in Questionnaire A.

MANAGING INSTRUCTION

The objectives for DMP teachers specified in this section will deal primarily with the assessment component of DMP, and how the teacher uses assessment information in order to make decisions about managing instruction. Since it is difficult to observe such decisions being made in the classroom, these objectives will usually be tested through questionnaires.

18. Using the appropriate assessment instruments, the teacher assesses students and completes the pupil performance records.

Assessment: Questionnaire A - Items 1 and 5
Observation Schedule - IV.6 and IV.7
Interviews with Teachers

The observer will note when the teacher assesses a student during an activity (IV. 6) and when the teacher records that assessment (IV.7). Also, Items 1 and 5 of Questionnaire A ask the teacher for information on the use of the assessment instruments and records. Additional information will be gathered by the staff of the R and D Center as they interview a random sample of teachers on the usability of the assessment materials.

19. The teacher states the roles of the Placement Inventories and Topic Inventories.

Assessment: Questionnaire A - Item 7

20. On the basis of information gathered from Placement Inventories and Topic Inventories, the teacher forms instructional groups based on achievement.

Assessment: Questionnaire A - Items 2 and 6

DMP assessment materials help teachers to place children accurately in the DMP sequence and to determine the children's achievement of each objective. Using this information, the teacher can assign children with similar needs to the same instructional group.

21. When presented with a student who has not mastered an objective, the teacher can choose an activity that will help the student reach that objective.

Assessment: Questionnaire A - Item 16

Each activity is designed to help children reach one or more of the objectives of DMP, and these objectives are identified as a part of the description of the activity. When given the objective, the teacher can find a related activity by reading the topic overview or the descriptions of the topic's activities.

22. The teacher re-directs individual students when they finish an activity.

Assessment: Observation Schedule - IV.8

This re-directing of students might involve beginning a new activity, peer tutoring on the activity just completed, or in some cases, working in an area other than mathematics. Re-directing need not involve formal assessment.

23. When given the appropriate information on student achievement, the teacher classifies students into two groups--those that have sufficient mastery of prerequisite behaviors to start a new topic, and those that do not.

Assessment: Questionnaire A - Item 10

DMP assessments use the ratings of Mastery (M), Making Progress (P), and Needs Considerable Help (N) in determining student achievement of an objective. A student has sufficient mastery of prerequisite behaviors for a topic if he has no "N" ratings.

24. The teacher identifies the various options (including choice and sequence of activities) that are made available in each topic of the Teacher's Guide.

Assessment: Questionnaire A - Item 12

The DMP Teacher's Guide gives the teacher a number of choices about which activities to do in each topic. Some activities are strongly recommended; others are alternate or optional activities. In Questionnaire A, teachers are asked to identify recommended sequences of activities for a topic; supplementary information on this objective will be obtained by noting the selection of activities used by teachers during classroom observations.

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Appendix E
Summary of Comments from Field Test Schools

9/1/71 - 1/31/72

Materials

Format, Packaging
Manipulatives

Teacher's Guide

General Comments
Topic and Activity-by-Activity Review

MATERIALS

Format, Packaging

1. The DMP system of numbering activities is very confusing.
2. Space should be provided on worksheets for the child's name.
3. For the information of parents, directions should be printed (perhaps in microtype) on the front or back of worksheets. Also, behavioral objectives should be stated on worksheets for teachers' benefit.
4. The schools definitely want all worksheets with answers printed in the manual (reduced size good). Answers should include annotations when they are relevant.
5. Pictures for stories, etc., should be printed on both sides and/or made larger.
6. Loose-leaf binder for topics is preferred; packet-by-packet (per topic) packaging of materials packet is liked.
7. Activities which are especially good for observing mastery might be marked in some way (beyond italics).
8. Behavioral objectives for each activity should be stated (written out).
9. Some teachers feel the sequence chart is hard to understand; others don't.
10. Art. Some teachers feel the characters are "way out" and distracting; two teachers from Chicago (inner city) did not agree--said kids like the characters.
11. The sections on materials, preparation, and the overview are generally adequate. Aides, however, have recently suggested the following improvements in the sections on materials and preparation:
    a. Be more specific, e.g., exact size of washers, number of containers per small group, etc.
    b. Have more illustrations.
    c. Provide sample kits of materials (examples).

Manipulatives

1. Grade 1 classes should have solids too.
2. Materials that school is supposed to buy (rubber bands, etc.) should be available in an optional kit that schools could purchase if they wished.
3. Balance beams are too time-consuming to get balanced and do not stay in balance. Pans themselves are of varying weights. Most worksheets and manual directions suggest that child should focus on the pans when it should be the beam.
4. Pegs are breaking on some geoboards.

TEACHER'S GUIDE

General Comments

1. Level 1 review activities tend to "jump around." For example, there is too big a gap between 1.3.3 and 1.4.3.
2. The prescribed Level 1 activities for P-1 classes require too much pasting and cutting, obscuring the objectives; they do not cover some important prerequisite concepts, such as equal sets, in depth.
3. Use of worksheets in kindergarten is too formal.
4. A parent brochure would be helpful.
5. Aides are considered essential for preparing materials. Volunteer mothers are also helpful. Aides are also useful for assessment and small group activities.
6. Tape-recordings could be used (with stories, etc.) to increase amount of independent activities and for review.
7. More self-check opportunites are needed (to increase amount of independent work which can be done).
8. Teachers have appreciated the inservice and feel it is absolutely essential.
9. The humor in the stories is often lost on the children and so teachers reword the stories.
10. Directions relative to vocabulary development are insufficient; i.e., teachers don't know

how much stress to place on it.

11. Why differentiate among levels?
12. More variety of media should be used to accommodate varied learning styles.
13. Several teachers mentioned difficulties children have with time concepts.
14. The question of DMP compatibility with IGE has been raised, especially with respect to preassessment and grouping.
15. Most teachers, especially in multiunit schools, are unclear how to proceed to form instructional groups.
16. More practical suggestions for grouping are necessary. Several suggestions have been discussed, some of which originated with teachers and which include modifications to increase the amount of independent work possible:
    a. (in MUS) each of several teachers would "take" a certain group of objectives (not necessarily a closed sequence) and be responsible for small groups of students needing work on these objectives
    b. work with groups of students on alternate days
    c. provide more activities with self-check possibilities, including tape-recorded activities
    d. have separate grouping for the geometry and arithmetic strands

Topic and Activity-by-Activity Review

Activity	Part	Worksheet	Problem
Topic 1.1			The topic is too long, generally, and therefore frustrating to children having difficulty.
1.1.1	A	a-d; c-f	There are too many worksheets in the activity--activity tends to get bogged down and DMP gets off to a slow start. Pictures are too detailed for children to focus on desired differences; gorilla and alligator aren't "seen." It is hard to find the twins--perhaps have only three objects with the odd one more obviously different. 1.1.1.e and f are better because there is only one <u>different</u> animal, rather than two different and two alike.
		a-b; c-f	The switch in task from "a-b" to "c-f" is confusing to the children.
	C		Part C is a disaster if tried in this activity; it is more successful after 1.1.12.
			Activity requires too many skills for beginning K-children; difficult to deal with pictorial representation; cutting and pasting OK.
	B,C	f	One camel is obscured by the others.
		g,h	Cutting and pasting are difficult for children. There is an error in directions which say "paste on elephant"; it should be "monkey." Some kids are confused by term "next in line" when actually the animal is "first"; it would be better if blank were at the "end" of the line.
1.1.2			At beginning of year it was difficult to get children to work in small groups; they do not have discussion skills, and the team competition aspect is "lost" on beginning K. Also, many children are unable to act as leader (picker); they do not understand scoring, tallying, etc., and also become impatient waiting for turns.
	A		Teacher directions are very confusing.
1.1.3			"Thing cards are <u>well</u>-liked."

Activity	Part	Worksheet	Problem
1.1.4			Humor of story was lost on children (one teacher). The idea of a letter to parents worked well.
			S.1. "I Spy" works well played outside.
1.1.5			There are no dotted lines on cards as stated in Preparation. Picture cards such as for 1.1.5b should be printed on both sides so both speaker and audience can see, and they should be much bigger.
	A		Doing "likenesses" and "differences" at the same time is confusing--the activity may be better placed later in the topic.
1.1.6			Pumpkin, Owl Cards work well; however, make sure they are drawn <u>exactly</u> the same (except for the attributes in question) because children find infinitesimal differences in the drawings of the eyes, for example, and focus on them.
		a	This is too easy.
		b	This is very difficult. There are many attributes for children to focus on, and drawings are too detailed.
		c,d	Activity is too hard; it cannot be done independently--drawings are too complicated. Creature in box should be positioned in top left-hand corner, rather than right, to encourage left-to-right eye movements for reading.
			Short, black printed lines on Owl Cards do not extend across the page. Teachers make use of the black lines to cut out the cards.
1.1.7			Picture cards a and j have interracial twins in the story "Cleaning Up the Classroom." Have follow-up activities more directly related to the story (beyond the discussion).
1.1.8			New vocabulary word "short" should be "sort."
1.1.9			The story "Johnny and the Buttons" states that Johnny's mother gave him "3" cookies, but the picture show three on the plate and one in his hand--a total of four.
		a,b	Not "meaty" enough--worksheets are done in a second or two and aren't worth duplicating. Suggest using a flannelboard activity.
1.1.12		a,b	It is difficult for children to circle the missing figure. Figures are too detailed for students to select the appropriate attribute of the pattern (except with turtles). Something simpler in form and design is desired. Also, the sheets are too quickly done--would be better to make another sheet of figures to cut and paste on to complete the patterns.
Topic 1.2			General comment: the topic should place more emphasis on the term "length" since it is used in the assessment. Also, because of describing "tall" things all through Topic 1, there is some confusion in the switch to "long." One teacher suggested that we warn teachers during Topic 1 to use "tall" and "long" interchangeably when referring to things like trees and people or else to avoid "tall" altogether.

Activity	Part	Worksheet	Problem
1.2.3			The variations are good; children really enjoy them.
			S.2. Should not have such emphasis on "tall" when you are trying to introduce "long."
1.2.4		a,b	The worksheets are good. Could name the men "Mr. Long" and "Mr. Short." Sheets are done more easily if stapled or pasted back-to-back.
1.2.5			Introduction of term "height" is very confusing; is it necessary?
1.2.6			Story is very thought-provoking. Some children saw only one orientation of objects in comparing and ordering on length.
1.2.7			One teacher expressed the reservation: "Why is the big guy always the one to win?"
		b	Pictures are too small to distinguish. Activity should suggest a review of patterns before children are asked to do the sheets.
1.3.1			The Lopsided Lily activity was well liked.
		a	The fact that the glare lines on the windows differed in number distracted some children--they wanted to equalize them.
		b	Ground level should be more definite.
		e	Very good because it forces a focus on length as opposed to numerousness. Should have more sheets, activities, etc. like this.
1.3.3	B		Directions and organization are too difficult for Grade 1 students--children seem lost in details of cutting and pasting. (Grade 1 students used the activity as a review--concept obscured by the cutting and pasting.)
1.3.3		b,c	The flower is seen as both an extension of the hat beneath it and as a separate hat--confusing.
			There are not enough blanks provided to equalize sets.
1.3.4			"Snarl" worksheet is generally difficult--might be better switched with 1.3.5. Also, make Snarl (the model) stand out more obviously. Many children failed to use him as a reference.
1.3.5			Directions for Chain Train are hard to understand, especially Step 3.
Topic 1.4			Some students have difficulty with left-to-right ordering and need introductory work. One teacher pointed out that she often works with her group in a circle and that therefore left-to-right is reversed; she felt work on ordering should not be done so kids see it in reverse (as when they are on opposite sides of a circle).
1.4.2			Directions should emphasize the need of a common starting line for ordering the rods.
1.4.3			Pasting required, after ordering of beasts, is beyond children's capabilities. One teacher objected to the use of words like "gotta" and "whatsa." It was also felt that

Activity	Part	Worksheet	Problem
			expressions on faces of animals (picture 1.4.3b) did not match the ending of story.
1.4.6			The illustration of answer to clown puzzle is incorrect.
1.5.2			Children required considerable help. The organization is too difficult for students. Expressions on pairs of animals were difficult to distinguish.
1.5.4	A		Clowns and dogs on Sheets 1.5.4a, b are too difficult (detailed) for children to copy.
1.6.6			S.3. One teacher tried this and had extreme difficulty in getting the point of the activity across. Children would consider only the general shape rather than the parts of the path, i.e., almost everything was crooked.
1.8.4		c,d	Cats shouldn't be in every set, since children ignore the dividing lines and include all cats in one set.
		d	Sets of cats and bird cages confused children; they didn't grasp concept of equal sets.
1.8.7	A,B		There were some problems in matching objects in Part A and in the Treasure Hunt in Part B.
1.12.1		a-d	Printed black lines are not conveniently spaced. If unobservant teacher cuts along the lines, she will find when pasting the pictures that two columns on the graph containing the same number of pictures will be of different lengths.
Topic 1.14			Children lost their rhythm counting.
1.14.16			Numerals are missing in Sheet I; the correct choice is missing in Sheet K.
1.14.18	B		Passing chains around the large-group circle does not work well. Small groups could be used or children could move with number cards.
1.14.20		a	Need colt rather than calf in first box. "Stops" in the story are missing.

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SUMMARY OF COMMENTS FROM
FIELD TEST SCHOOLS

9/1/71 - 1/31/72

Assessment Program

General Comments
Component Review

ASSESSMENT PROGRAM

General Comments

1. Concern was expressed about the time and personnel required to administer the individually-administered tests.
2. It is difficult to determine when to give M (mastery) or P (making progress), especially in individually-administered tests.
3. It would be helpful to the administrator for individual tests if hints were categorized or somehow related to the rating decision.
4. Use of Pupil Performance Records. Very few teachers are using either Individual Record Sheets or Group Record Cards.
5. Many teachers find it difficult to observe all students, but instead pick out those they feel are having difficulty.
6. The purpose of Form 2 of Placement Inventory B should be discussed in the Assessment Manual.
7. Regrouping after interpretation of placement inventory results probably should be discussed somewhere.
8. Some Placement B results were not substantiated by Topic Inventories; especially Topic Inventories 2 and 4.
9. There was concern that the program lacks preassessment opportunities.
10. Teachers have noticed that although a child can demonstrate he knows an objective with manipulatives, he cannot do so on worksheet, and vice versa. It is very unclear to them which type of performance to rely on to judge for mastery in this case.
11. Some teachers expressed a preference for periodically-given topic inventories (rather than topic-by-topic) because (1) they allow a retention check and (2) they are less time-consuming. However, they dislike the nonsequential inventories (e.g., for Topics 1, 3, 5).
12. Task sheets are hard to keep track of. It would be good to print them (reduced size) within the manual or directions.

Assessment Component Review	Problem
Teacher Observations	Teachers want to know more precisely what response is necessary.
	What alternatives are satisfactory as they use the observations (italics)?
Topic Checklists	Used to varying degrees. Some teachers prefer to mark them only at the end of a topic. Large classes are particularly difficult to observe. Teachers have suggested color-coding to increase usability of Topic Checklists for grouping.
Topic Inventories	Some teachers would like response-rating sheets for individuals within a class.
Topic Inventory 1, Level 1	See 11-29-71 memo from Nancy Zajano for detailed comments related to Tasks 1-5.
Topic Inventory 1, Book 1, Task 1	Children could not discriminate between likenesses and differences; likenesses were especially hard.
Tasks 1, 2	Words "two" and "three" should not be used with children who don't necessarily have this concept yet. Use the word "same" instead.
Task 2	Task 2 is subsumed in Task 1; children missed attribute of roundness, probably because of no other shape for comparison.

Task 3	Children focused on pairing, rather than putting all four of one size together.
Task 5	Children focused on pairing. They didn't look at all the clowns or faces.
	Smiles and frowns may be more evident on the "faces" than on the clowns; expressions were difficult to distinguish especially on the clowns.
p. 1	No directions for "If child is repeating..."
p. 46	To be parallel to Form 1, "Say" should say "What do all these faces..."
Manual	Might contain a "flag" about the Topic Inventories at the very end of the topic activities as well as at the end of the Overview.
	Might contain a table of contents or index or other summary of Topic Inventories within Book 1 itself.
	Answers are wrong. It might be made clearer in the directions whether "hesitate" means the same as "starts to do the task wrong," or "does the task only partly correctly," or "does the task incorrectly."
Topic Inventory 4	Children focused on the length of the paper clips lined up, rather than the numerousness.
	Directions are too long.
	Addition of the direction "Point to the circle" before "Fill in" for the first few items would resolve many problems.
Placement Inventory A: Manual	Teachers and/or aides have made comments regarding (1) changing the language to something more familiar to the child and (2) how much of a hint to give to a student.
	Suggestions or guidelines on how to give an inventory would be helpful.
	Although most kindergarten teachers used the Inventory, none used it for grouping. Perhaps a discussion of grouping should be added to the Manual.
	Directions are too involved and very wordy. Children could not deal effectively with two math concepts on the same page. Required 1 1/2 hours to administer.
Placement Inventory B	It takes considerable time (50 min. to 1 hr. 40 min.) to complete.
	Directions are too long and complex, especially for students with short attention spans and language deficiencies.
Placement Inventory B:	
Items 5a, 5b, 8a	These items have received considerable criticism in terms of whether or not they actually test the objective.
Item 2, Form 1	Trailer house was not recognized as a place to live in by most inner-city kids.
Item 2, Form 2	Sailboat was not recognized as a means of traveling (Sparta children).
Examples C, D, Items 4c, 4d Item 10a	There are problems of perspective with art work; on Items 4c and d, one is closer than the other. For Item 10a left-hand side of cabinet could be interpreted as a door also.

All items	Make sure students are following directions--it was suggested that students place their fingers on (1) the appropriate problem and (2) the answer before marking it. More assistance on interpretation and use of test results is necessary. Children are confused by two kinds of directions in close proximity (like X-ing out, filling in). Vocabulary used in the test differs from that in Book 1.

SUMMARY OF COMMENTS FROM
FIELD TEST SCHOOLS

9/1/71 - 1/31/72

Specific Comments

Book 2

Activity	Problem
2.1.1	This is quite an involved activity with long preparation for the teacher or extra activity for students.
2.1.3	Concept of straight edge and corners is difficult. Could be taught in smaller steps.
2.1.5	Students do not know when they win. Teacher needs to be warned to give instructions.
2.1.7	Children do not offer averaging.
2.2.1	There is a need for objects that are alike in all ways except weight.
2.2.2	Graphing and tallying are new to this level and were difficult for Grade 1 students who did not have Level 1. Could use a reference to Level 1 activities. Suggested activities are good.
2.2.3	Instructions related to balance are confusing--should focus on balance beam, not on container.
2.2.6	Children did not do too well--could not get the idea of voting. Perhaps some examples would assist the teacher in presenting the activity.
2.2.8	Too many tasks are required in completing the sheets, all requiring a circle. The sheets do not progress from simple to difficult and the characters need to be more distinguishable.
2.3.1	This is a confusing activity with more than one sequence possible. Teacher should be alerted to the situation.
2.3.5	Game 1 is a difficult game and was not played in Chicago. Complications arise over trading places. Recommendation for indoor recess in order to prepare for it. Game 2 is confusing in terms of which seat to go to. The poems went well.
2.3.6	This is a troublesome activity--too many directions. Children do not tally--they go directly to the graph. It is a good activity but needs simplifying.
2.3.7	The middle position is the hardest pattern to find. Children could use some help in the way of review. Perhaps concrete examples would help.
2 4.1	There are some problems with drawing on the worksheet. Tallying is not used again. Is it needed?
2.4.2	Some confusion arose over the concept of weighing. The weighed object was being confused with the weights. Teacher could use a little help here.
2.4.4	There is a competition component to this activity which interferes with the activity--children try to get as many links as possible. Matching with the teacher heightens this problem and is a procedural hassle.
2.4.8	Directions are a disaster--lids are not included and the size of the washer makes the table inapplicable in some cases. Actually is too long to get a good discussion out of it. It's a good activity, however, and just needs to be reworked.
2.4.10	Children confused matching of sets with matching elements. Some warning would help.
2.5.2	Procedurally this is a difficult activity: story too long, figures too similar, and use of matrix too sophisticated. Children had trouble drawing accurately.
	The students did not see that dots were inside in Part C. Could have used review from 1.6 or an activity using children and a rope.

2.5.4	Sheets e, f, g, h are quite intricate. Recommend using for students who master previous work.
2.5.8	Transferring to dot paper is very difficult--good thing it's not an objective. Children could use some help with easier steps.

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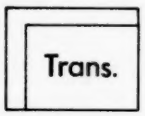
FURTHER COMMENTS FROM
FIELD TEST SCHOOLS

2/1/72 - 3/1/72

Book 2

Activity	Problem
2.4.1	A discussion should be specifically suggested following this activity; needs closure. Perhaps discuss worksheet.
2.4.2	If washers do not come with materials kit, other suggestions should be given for good materials, as bottle caps, marbles, etc. Suggest a section called "How to Use the Balance Beam" (for teachers), e.g., explaining whether you look at the beam, pan, or both. Again, suggest that follow-up discussion is particularly essential.
2.4.4	Suggest asking "Who has less?" "Six links short" terminology throws students.
2.4.7	Discussion is essential; teachers felt the children could verbalize but doubted that they really understood the concepts.
2.4.8	Too complex. Why not weigh four different objects with any one unit, then draw a picture of each object (rather than labeling A, B, C, D). Felt that doing the activity without containers would be simpler and just as meaningful. Suggests, unless we have better beams, that children trade beams too.
2.4.9	Why not weigh dry sponge first to save time?
2.4.10	Dashed lines are confusing. "Bad" worksheets.
General: Topic Inventory 1	Results indicate the need to emphasize the unit of measure each time. This is one reason for discussion as suggested in 2.4.1 and 2.4.2 above.
2.5.6A	Masking tape to mark faces counted is essential (like S.1.).
2.5.7	Teacher preferred "Additional Suggestion" to the activity. When objects are bigger than the face on face card, kids cannot see their error.
2.5.8	"I made sheets for the overhead showing a geoboard sheet (like the worksheet)--had the children make figures on the geoboard (simple ones) that I had to transfer. Then I asked them to choose a partner. One partner had to make a very simple 4-sided figure and his partner had to make it on the geoboard paper which was under what we call our 'magic slates' (a piece of heavy overhead transparency paper on cardboard taped together, allowing a paper or worksheet to be placed on it).



"Then they decided together if the transfer was correct. If it was, they came up to me in partnership, one with the geoboard and one with the 'magic slate' and we checked it together (noting the number of pegs on the path, inside, outside, etc.), then the other partner made a simple 4-sided figure on the geoboard and proceeded in the same way as before. If the transfer was not correct, it was discovered in our conversation or discussion of where the pegs were located and the partner simply used a cloth to erase the crayon on the magic slate and corrected it. After working with simple 4-sided figures for a time we proceeded to do 3, 5, 6, etc. I started with 4-sided figures because the straight-lined squares and rectangles were easier for the kids to see and transfer. The slanted lines of triangles are more difficult for children of this age.

"I saved many worksheets using the 'magic slates.' My children and I enjoyed doing this activity. I allowed partners as much time as necessary to work with the simple 4-sided figures and allowed the partners who achieved this skill faster to go on to 3, 5, 6, 7, 8 figures at their own rate."

(Mary Ann Padol)

2.6.1	Worksheets could be made into book.
2.6.2	Children loved activity.
2.6.3	Is a container necessary? Could you label objects A, B, C, D?
2.6.4,5	These were well-liked activities.
2.6.6	Some children thought only objects which looked exactly like the key pictures should be counted.
2.6.7	Children had trouble with Mine, Yours, Ours idea. Objectives were lost in confusion.

General (2.6)

For children who have been "ideal" DMP students and have not written numerals before:

1. There are too many numerals worked on in each activity--they should be "spread out." Early activities require too many numerals at once.
2. There are not enough "numeral formation" (tracing, etc.) models, sheets.
3. Each worksheet should have a model on it. Perhaps practice in the mechanics of writing numerals could have (2.6.1) taken place prior to this topic.

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